CBRN APR Human Factors

Notional Test Protocols

Methods: Combination of Unmanned Test Platforms & Human Wear Trials Resulting in a Current Negative Pressure Operational Focus

Procedures: Select blend of enhanced and/or actual tests from NIOSH, EN, NFPA, ANSI, ASTM, & Mil-Specs.

8 CBRN APR Human Factors:

- Breathing Resistance
- Communications
- Field of View
- Lens/Visor Optics
- LRPL/Donning (Systems Test)
- Lens/Visor Fogging
- Carbon Dioxide (*as needed*)
- Hydration (*as needed*)

Test Agencies: NIOSH, SBCCOM, & Certified Contract Facilities.

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Breathing Resistance: Notional Protocol

Methods: Per 42 CFR 84.122, 84.203, RCT-APR-STP-0004

Procedure:

- Headform tests with continuous air flow rate of 85 L/min.

Requirements:

- Inhalation Resistance w/Mechanical Particulate Filter (P100):

	Face mounted	Non-face mounted
Initial:	65 mm H_2O	70 mm H_2O
Final:	80 mm H_2O	85 mm H_2O

- Exhalation : *20 - 26 mm H_2O* *20-26 mm H_2O,* 26mm is proposed

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Communications: Notional Test Protocol

Method: Modified NFPA 1981 & ANSI

Conditions:

- Masked and unmasked (control) trials
- Constant background noise of 60 dB(A)

No. of Test Participants: 3 Listeners & 5 Speakers

Procedure:

- Modified Rhyme Test (MRT) – phonetically balanced speech intelligibility test.
- One speaker and 3 listeners per MRT trial (50 stimulus words).
- Data obtained with and without respirator wear for both speakers and listeners.
- 10 MRT trials (2 x 5) required to complete test matrix.

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Communications: Notional Test Protocol

Data Analysis:

- Listener performance calculated for each MRT trial

  % Correct = (# correct – (# incorrect / 5)) x 2

- Average individual listener's MRT scores for their masked and unmasked conditions.

- Calculate *Performance Rating* scores for each listener

$$\textit{Performance Rating} = \frac{\textit{Ave MRT Score}_{masked}}{\textit{Ave MRT Score}_{unmasked}} \times 100$$

- Average performance ratings of all 3 listeners.

Proposed Requirement: Average *Performance Rating* ≥ 70%

Vision Testing: Notional Test Protocol

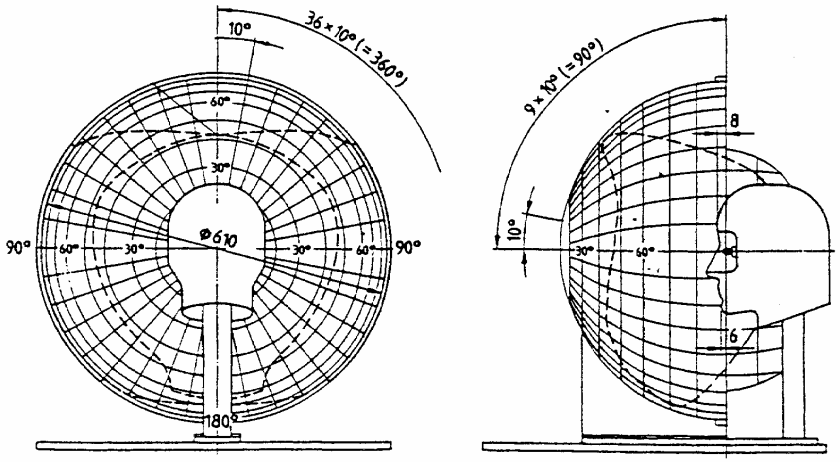
Methods: Objective measure of Field of view (FOV)

Procedure:

- Adaptation of EN136, *"Full face masks for respiratory protective devices."*
- FOV assessed methods equivalent to EN136, section 5.8.
- Express results as a percentage of the area of the 'natural' field of vision.

Proposed Requirement: EN136, 4.13.3

- Visor: Overall FOV ≥ 70%
  Overlapped FOV ≥ 80%
- Dual-lens: Overall FOV ≥ 70%
  Overlapped FOV ≥ 20%



Lens Abrasion and Optical Haze: Notional Test

Methods: Per NFPA 1981 6.9, *Facepiece Lens Abrasion Test*

Procedure:

- Haze tested in accordance with ASTM D1003, *Standard Test Method for Haze and Luminance Transmittance of Transparent Plastics,* with additions.
- Haze testing of multiple lens samples before and after abrasion.

Requirements:

- Average delta haze value of all samples ≤ 14% or 10%.

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Lens/Visor Fogging: Notional Test Protocol

Method: Human wear trials

Conditions:

- Cold: minus 21 °C (- 6 °F)
- Cool & humid: 15.5 °C (60 °F) at 75% RH

No. of Test Participants: 2 per test condition

Procedure:

- Baseline visual acuity (Snellen eye charts or equivalent)
- 4 hour respirator environmental conditioning.
- Respirator donning followed by test of visual acuity.
- 5 min walk (4.8 km/hr (3 mph)): 2 min rest: 5 min walk: rest
- Measure visual acuity during rest periods. Outserts evaluated.

Lens/Visor Fogging: Notional Test Protocol

Data Analysis:

- Calculate *Performance Rating* scores for each visual acuity measure obtained during respirator testing.

$$Performance\ Rating = \frac{VA_{masked}}{VA_{unmasked}} \times 100$$

- Average performance ratings for each individual subject.

$$Ave\ PR_{TP\ 1} = \frac{PR_{don} + PR_{rest1} + PR_{rest2}}{3}$$

Proposed requirement: Average *Performance Rating* ≥ 70% or 90% minimum for each environmental condition for each subject.

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Carbon Dioxide Retention: Notional Test

Methods: Per 42 CFR 84.97, RCT-APR-STP-0064, dated 4/26/2001.

Procedure: OPTIONAL Based on Configuration of Application.

- Adaptation of open-circuit SCBA test for CO_2 in inspired gas.
- APR headform mounted; CO_2 measured at mouth during inhalation for 3 respiratory cycles. Oxygen concentration ≥ 19.5%.
- Exhaled air contains approximately 5% CO_2 concentration.
- Applicable to secondary neck dam or shrouded neck piece on a non-powered "gas" mask with a tight fitting neck "seal."

Requirements:

- Maximum allowable average inhaled CO_2 concentration ≤ 2 % or 4%.
- Linear deflection plot generated from testing three (3) respirators.

CBRN APR Hydration

Methods: NIOSH RCT-APR-STP-0014
and US Army CAT Method(s)

Procedures: OPTIONAL, Based on Configuration of Application

- Analyze drinking tube leakage on dry drinking tube valves, seats and seals.
- Analyze contamination levels in water over a 24 hour period.
- Dry Drinking device analyzed separately under GB/HD SMARTMAN Systems Testing.
- NIOSH method: 75 mm of H2O via Gilibrator Bubbler under STP – 0014.
- CAT method: GB and HD contaminate a drinking device surface, water samples are taken at defined time intervals and analyzed by GC for agent concentrations.

Requirements:

- 9 Trials, 3 Trials per respirator.
- Leakage between valve and valve seat shall not exceed 30ml per min.

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Notional Test Protocol Summary

- Maximum 8 HF tests / minimum of 6
- 6 Basic Human Factors (HF) tests (5 + LRPL)
- 2 Optional HF tests
- Verification testing IAW NIOSH Test Matrix
- HF Testing is Coupled with Systems and Environmental Testing
- Exhalation Resistance: 26 mm H_2O
- Communications and Fogging Performance Ratings: 70% or 90%
- Hydration: Optional, Examines Leakage, H2O Analysis & LAT
- CO_2 Test : Optional based on Application Configuration
- LRPL Passage Rate of 100% and 1,000 or 2,000 or 3,000 LRPL FF.